GEOPOLYMER MATRIX FOR THE INERTIZATION OF GOLD MINE TAILINGS

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The mining industry produces a huge amount of solid waste materials during mining's lifetime. Solid mine tailings typically contain many sulfide minerals and heavy metals. These fine-grained residues are usually deposited in impounding lakes near mining sites. Sulfides are oxidized in contact with water, which decreases the surrounding pH, and metal oxides are leached into the environment. This leachability causes short- and long-term environmental problems, such as contamination of surface and ground water. There is increasing interest in discovering new methods to manage mine tailings more effectively in the future. This interest is mainly focused on developing low-cost treatment or confinement processes. The possibility of immobilizing several heavy metals from gold mine tailings by reactive geopolymerization technique has been investigated in the present study. The chemical stability of geopolymers synthesized by the alkali activation of metakaolin and blast furnace slag with the addition of 40 to 50 wt% gold mine tailings is demonstrated. The geopolymers were cured at room temperature, and the effects of different Si/Al and Na/Al molar ratios and curing times were investigated. The inertization effectiveness was evaluated by means of leaching tests carried out according to standard EN 12457 after 7 and 28 days and after 18 months. The samples were immersed into the water for 1 day, and the leachable metals in the test solution were determined by ICP-OES.

Table 1. *Geopolymers containing 40 wt% ot mine tailings (MT) release test results after 7 and 28 days and 18 months of curing compared to as received MT. *QL = Quantification limit*

	Cr ppm	**Cu ppm**	**Ni ppm**	**Zn ppm**	**V ppm**	**As ppm**	**Sb ppm**	**Mn ppm**
Total concentration in MT powder	74	120	100	71	59	1520	32	1500
Leachable from MT powder	0,3	0,2	0,1	0,5	1,3	68	0,1	4,2
geopol (7d)	0,7	1,7	0,3	0,6	63	133	0,2	1,4
geopol (28d)	0,6	0,1	0,3	0,1	5	24	0,7	3,5
geopol (18months)	0.11	0.05	< QL	<QL	1.3	0.12	< QL	< QL

The results show that various elements (Cr, Cu, Ni, Zn and Mn) from gold mine tailings have been immobilized almost completely by alkali activation with proper co-binder material. The problematic oxyanions (As, Sb, B, and V), after 18 months of curing time, show leaching values very low in line with the disposal in landfill for no dangerous wastes. These results are very important because confirm the improvement of the consolidation degree with time for the geopolimeric matrix.